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TITLE: APPARATUS FOR MULTIPLEXING LINE AND DATA TRANSMISSION METHOD USING THE SAME

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APPARATUS FOR MULTIPLEXING LINE AND DATA TRANSMISSION METHOD USING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus for multiplexing a line, and more specifically, to an apparatus for multiplexing a line and a data transmission method that improves data transmission efficiency.

2. Background of the Related Art

Related art intra-network systems are widely used in accordance with a rapid worldwide development of telecommunications technology. In a related art intra-network system, local area network (LAN) systems connect computers, telephones and facsimile machines. Data communication between various related art intra-networks can be performed wherein an apparatus for multiplexing a line is provided in each intra-network, and wherein each of the respective apparatuses for multiplexing a line are connected by a trunk.

Figure 1 illustrates operations of the related art apparatus for multiplexing a line, including multiplexing during data transmission and demultiplexing during data reception. When multiplexing during data transmission, an input signal is generated. If the input signal is a voice signal generated from a telephone 10a, a signal from a facsimile machine 10b, or a signal from a modem 10d of a computer 10c, the signal is transmitted to a voice line connector 10 that modulates the signal by a pulse code modulation (PCM) mode and transmits the modulated

signal to a multiplexer/demultiplexer 30. Thus, an input signal at 8Kbps or 14.4Kbps can be converted to the modulated signal at 64Kbps.

However, if the input signal is a data signal generated by a computer 20a, the data signal is transmitted to a data line connector 20 that modulates the data signal by the PCM mode and transmits the modulated data signal to the multiplexer/demultiplexer 30.

The multiplexer/demultiplexer 30 respectively assigns channels to the modulated signal from the voice line connector 10 or the data line connector 20 by a time division multiplexing (TDM) mode, and outputs the modulated signal to an output line connector 40 that transmits the modulated and multiplexed signal to a trunk coupled to other apparatuses for multiplexing a line.

The TDM mode divides a number of data or digitized voice signals into a certain time (i.e., time slot) to multiplex a plurality of channels. Therefore, the related art apparatus for multiplexing a line assigns one time channel to each user application, and performs data transmission or reception through that channel. The assigned channel is maintained until the user application terminates data transmission or reception. Thus, during periods that a particular user application is inactive, the data handling capacity assigned to that user application will be wasted.

However, the related art apparatus has various problems and disadvantages. For example, the related art apparatus allows data transmission within a tolerance limit of an overall channel capacity, and when the number of users exceeds a threshold value of the overall channel capacity for a particular time, a standby time period is required for data communication between

subscribers in different intra-networks. Additionally, quality of service may deteriorate due to a heavy load on the related art apparatus. To solve this problem, the overall channel capacity can only be increased by increasing the number of the related art apparatuses and the number of trunks, but additional costs and construction work time will result.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an apparatus for multiplexing a line and a data transmission method therefor that substantially obviate one or more of the problems and disadvantages of the related art.

It is another object of the present invention to provide an apparatus for multiplexing a line, and a data transmission method therefor, to improve data transmission efficiency.

It is also an object of the present invention to provide an apparatus for multiplexing a line, and a data transmission method therefor, wherein overall data capacity can increase without a need to increase individual channel capacity, and without a need to increase the number of apparatuses and trunks.

An apparatus for multiplexing a line embodying the present invention includes a plurality of conversion processors for modulating a call processing request signal or transmission data from each user application by a predetermined mode and then demodulating again the signal or data to an original data, or demodulating an externally input call processing request signal or transmission data by a predetermined mode and providing a demodulated signal to a corresponding user application. The apparatus also includes a main controller for implementing

the call processing request signal respectively provided from the conversion processors, respectively outputting a call control data added to the transmission data in a header type, and separating header data included in the externally provided transmission data, and a multiplexing/demultiplexing processor for logically multiplexing the call processing request signal or transmission data output from the main controller and demultiplexing an externally provided multiplexing signal.

A data transmission method embodying the present invention uses an apparatus for multiplexing a line that includes a plurality of conversion processors connected with a plurality of user applications, a main controller, and a multiplexing processor. The method includes the steps of: primarily modulating a call processing request signal or transmission data provided from the user applications by a pulse code modulation (PCM) mode and then demodulating the same to an original data; implementing the call processing request signal at the main controller and respectively outputting call control data added to the transmission data in a header type; and logically multiplexing the call processing request signal or transmission data at the multiplexing processor.

Another data transmission method embodying the present invention may also include the steps of: demultiplexing an externally provided multiplexed input signal at the demultiplexing processor; implementing a call processing request signal provided from the demultiplexing processor at the main controller and separating header data included in transmission data provided from the demultiplexing processor; demodulating the signals provided from the main

controller at each conversion processor to provide a demodulated signal to a corresponding user application.

An apparatus for multiplexing a line embodying the present invention may include a plurality of conversion processors, wherein each conversion processor is configured to modulate one of a call processing request signal and transmission data provided by a user application to create an interim signal. Each conversion processor would also be configured to demodulate the interim modulated signal to create a secondary original signal. The conversion processor is also configured to demodulate an externally provided signal and to provide the demodulated signal to a corresponding user application. The apparatus also comprises a main controller configured to process call processing request signals from at least one of the conversion processors, to generate call control data that is added to transmission data in at least one header field, and wherein the main controller is configured to separate header data included in an externally provided signal. The apparatus further comprises a multiplexing/demultiplexing processor configured to logically multiplex signals output from the main controller, and to demultiplex an externally provided signal.

A data transmission method embodying the present invention comprises the step of modulating a call processing request signal or transmission data provided from a user application by a pulse code modulation (PCM) mode to create an interim modulated signal, and demodulating the interim modulated signal to create a secondary signal. The method also comprises the steps of processing a call processing request signal from the conversion processor with a main controller that is coupled to the conversion processor to generate call control data

that is added to transmission data in at least one header field, and logically multiplexing signals output from the main controller with a multiplexing processor, wherein the multiplexing processor is coupled to the main controller.

A data transmission method embodying the present invention may also comprise the steps of demultiplexing externally provided multiplexed input signals with a demultiplexing processor, processing a call processing request signal transmitted from the demultiplexing processor with a main controller coupled to the demultiplexing processor, and separating header data included in the call processing request signal provided from the demultiplexing processor. The method further comprises the step of demodulating signals provided from the main controller with one of a plurality of conversion processors to transmit the signal to a corresponding user application, wherein each of the plurality of conversion processors is coupled to the main controller and the corresponding user application.

Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objects and advantages of the invention may be realized and attained as particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in detail with reference to the following drawings, in which like reference numerals refer to like elements, and wherein:

Figure 1 illustrates s a block diagram of a related art apparatus for multiplexing a line;

Figure 2 illustrates a block diagram of an apparatus for multiplexing a line according to a preferred embodiment of the present invention;

Figure 3 illustrates a call control information type used in the preferred embodiment of the present invention; and

Figure 4 illustrates data communication wherein two apparatuses for multiplexing a line according to the preferred embodiment of the present invention are coupled to each other through a trunk.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 2 illustrates a block diagram of a first apparatus 1000 for multiplexing a line according to a preferred embodiment of the present invention. The first apparatus 1000 includes a plurality of conversion process 100a~100n coupled to a main controller 300, which is coupled to a multiplexing/demultiplexing processor 200. The plurality of conversion processors 100a~100n can modulate an original outgoing signal, for example a call processing request signal or transmission data from various user applications such as telephones, facsimile machines and/or computers using PCM modulation. The conversion processors 100a~100n also demodulate incoming call processing request signals or transmission data back to the original signal. Thus, the first apparatus 1000 can process call processing request signals or transmission data from a second apparatus having substantially similar features as the first apparatus 1000,

which are received through a trunk, using PCM type demodulation, and provide the demodulated signal to a corresponding user application.

The main controller 300 in the first apparatus 1000 receives call processing request signals transmitted by the conversion processors 100a~100n, and outputs call control information that is added to transmission data in a header. Additionally, when receiving incoming signals, the main controller 300 can separate the header from the transmission data provided by a second apparatus. The multiplexing/demultiplexing processor 200 logically multiplexes outgoing call processing request signals or transmission data transmitted by the main controller 300, and demultiplexes the incoming multiplexed signals provided by a second apparatus through a trunk.

Figure 3 illustrates the format of call control information used in the preferred embodiment of the present invention. The data format includes a message type field 301 indicative of one of setting, release and maintenance of a call, a port discriminator field 302 indicative of discriminators of the conversion processors 100a~100n, a user information characteristic field 303 including information corresponding to a signal type (e.g., voice signal, facsimile or data signal, or data coding mode of a user application, modem mode, or communication line speed) and a user information field 304. The call control information is entered into the header by the main controller 300.

While the preferred embodiment of the present invention can be used for voice, facsimile, and computer signals, the present invention is not limited to those signals. For

example, pager, cellular, or other communications signals may be used in various embodiments of the present invention.

As illustrated in Figure 2, each of the conversion processors 100a~100n further includes a first line connector 110 that can communicate with the user application, a PCM modulator 120 that can modulate a signal transmitted from the first line connector 110 by the PCM mode, and a digital signal processor 130 that can determine a type of a signal provided from the PCM modulator 120 and can output the provided signal to a path corresponding to the determined signal type. The conversion processors 100a~100n also include a modulating/demodulating portion 180 that can demodulate signals transmitted from the digital signal processor 130 and modulate signals provided from the main controller 300. The conversion processors 100a~100n also include a first connection controller 170 that can control signals output from the demodulating/modulating portion 180 to the main controller 300 and produce a serial signal.

The demodulating/modulating portion 180 includes a first demodulator/modulator 140 that can demodulate an outgoing voice signal output from the digital signal processor 130 to an original voice signal, or modulate an incoming voice signal provided from the main controller 300. A second demodulator/modulator 150 can demodulate a facsimile signal output from the digital signal processor 130 to the original facsimile signal, or modulate an incoming facsimile signal provided from the main controller 300. A third demodulator/modulator 160 can demodulate a data signal output from the digital signal processor 130 to an original data signal, or modulate an incoming data signal provided from the main controller 300.

The multiplexing/demultiplexing processor 200 includes a second connection controller 230 that can control the call processing request signal and transmission data provided from the main controller 300 to produce a serial signal. The multiplexing/demultiplexing processor 200 also includes a modem processor 220 that can convert an outgoing signal output from the second connection controller 230 to an analog signal, and a second line connector 210 coupled to the modem processor 220 that can communicate with a second apparatus through a trunk line.

Call setting between the multiplexing/demultiplexing processor 200 and the conversion processors 100a~100n is accomplished by a method according to a preferred embodiment of the present invention. If a user application requests call processing relating to setting, maintenance and release of a call using telephones, key-phones and a private branch exchange (PBX), each user application requests a call processing using a loop dial (LD) mode, an ear and mouth (E&M) mode or a tip/ring(T/R) mode common to the telephone. The call processing request signal is then transmitted to one of the conversion processors 100a~100n provided in the first apparatus 1000 through a corresponding line. The corresponding conversion processor (e.g., 100a) transmits the call processing request signal to the main controller 300 to implement the user's desired call processing operation.

The call processing request signal processed by the main controller 300 is then transmitted to the second line connector 210 through the second connection controller 230 and the modem processor 220. Next, the main controller 300 matches a signal mode of the first line connector 110 of the conversion processor 100a to a signal mode of the second line connector

210 if the signal mode of the first line connector 110 and the second line connector 210 substantially differ.

The call processing request signal is transmitted from the second line connector 210 through a trunk coupled to a second apparatus. The main controller 300 of the first apparatus 1000 implements the call processing operation if the second apparatus sends back a response signal. If two or more users transmit call processing request signals or transmission data at a substantially same time, the main controller 300 controls the call control information of the types shown in Figure 3 to add the call control information to the originating user information in the header.

If a call is set up between the first apparatus 1000 for the origination party and the second apparatus for the termination party, the user application at the origination party initially transmits the user information through a port of the conversion processor (e.g., 100a). Then, the first line connector 110 of the conversion processor 100a communicates with the user application and receives an analog signal of 8 Kbps or 14.4 Kbps.

The PCM modulator 120 then modulates the analog signal received in the conversion processor 100a to a digital signal of 64 Kbps and transfers the modulated signal to the digital signal processor 130, which analyzes the digital signal output from the PCM modulator 120 to determine whether the signal transmitted to the conversion processors 100a~100n is a voice signal, a facsimile signal or a data signal.

If the input signal is a digital voice signal, the digital signal processor 130 can apply the input signal to the first demodulator/modulator 140 to demodulate the digital voice signal to the

original voice signal. If the input signal is a digital facsimile signal, the digital signal processor 130 can apply the input signal to the second demodulator/modulator 150 to demodulate the digital facsimile signal to the original facsimile data. If the input signal is a digital data signal, the digital signal processor 130 can apply the input signal to the third demodulator/modulator 160 to demodulate the digital data signal to the original data signal. Thus, the digital signal of 64 Kbps is demodulated to the original analog signal of 8 Kbps or 14.4 Kbps, such that if the digital signal of 64 Kbps is demodulated to the analog signal of 8 Kbps, then eight users can simultaneously use one channel.

The transmission data output from the first through third demodulators/modulators 140, 150 and 160 are converted to serial data by the first connection controller 170. The main controller 300 adds the call control information shown in Figure 3 to the serial data output from the first connection controller 170 in a header.

The main controller 300 transmits the serial data, including header data, from the first connection controller 170 to the modem processor 220 through the second connection controller 230 of the multiplexing/demultiplexing processor 200. The modem processor 220 converts the serial data, including header data, to an analog signal and inputs the analog signal to the second line connector 210 of the multiplexing/demultiplexing processor 200. The transmission data of the analog signal in the second line connector 210 is then transmitted to the second apparatus at the termination party through the trunk.

Figure 4 illustrates data communication according to a preferred embodiment of the present invention, wherein the first and the second apparatuses 1000, 1000' are coupled to each other through the trunk 2000.

The first apparatus 1000 is the origination party, the second apparatus 1000' is the termination party, and the first and second apparatuses 1000, 1000' have a substantially identical internal construction. The procedures for receiving data transmitted through the trunk 2000 to the second apparatus 1000' are described below.

First, the transmission data of an analog signal type is transmitted to the second apparatus 1000', at the second line connector 210 of the multiplexing/demultiplexing processor 200 coupled to the trunk 2000. The analog signal transmitted to the second line connector 210 is then converted to digital data by the modem processor 220, and the digital data is converted to serial digital data by the second connection controller 230. The main controller 300 receives the serial digital data from the second connection controller 230 and separates the call control information added to user information illustrated in Figure 3 in the header.

After the main controller 300 separates the call control information in the header, the main controller 300 transmits user information of a serial digital data type to the digital signal processor 130. The digital signal processor 130 demodulates the signal by the PCM mode to generate an analog signal, which is transmitted to the respective user application (e.g., telephone, facsimile machine and computer modem) through the conversion processor 100a corresponding to information contained in the port discriminator field 302 in the call control information shown in Figure 3.

The embodiments of the apparatus for multiplexing a line and methods therefor according to the present invention have various advantages. For example, in case of data communication between subscribers of different intra-networks having the apparatus for multiplexing a line, the transmission data is demodulated to original data and then transmitted, which increases overall channel capacity greatly without increasing individual channel capacity. Thus, even if the number of subscribers increases or the use of a line concentrates for a particular period of time, transmission efficiency of the trunk can be improved without increasing the number of apparatuses and trunks.

The foregoing embodiments and advantages are merely exemplary and are not to be construed as limiting the present invention. The present teaching can be readily applied to other types of apparatuses. The description of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures.